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EFFECTS OF THE MOISTURE CONTENT OF WHEAT ON THE TOXICITY OF INSECTICIDAL DUSTS CONTAINING PIPERONYL BUTOXIDE AND PYRETHRINS[1]

DONALD A. WILBUR[2]

A series of laboratory studies were made with insecticidal dusts containing piperonyl butoxide and pyrethrins impregnated in pulverized wheat. These were mixed with wheat to protect it from grain-infesting insects, the moisture content of the wheat receiving particular attention. The general effects of the moisture content of grain on the life economy of grain-infesting insects has long been known. When the percentage of moisture is low, the insects are unable to survive. As the moisture content is increased up to approximately 15 percent, the grain is progressively more favorable for the establishment of populations of grain-infesting insects and for the development of their progeny.

As the moisture of grain is increased, the toxic effectiveness of fumigants is decreased. Recent investigations by Rowell (3) showed that as the moisture of corn was raised, appreciably larger dosages of the standard grain fumigants were required to obtain corresponding kills of the rice weevil. It was not determined whether this phenomenon resulted from increased resistance on the part of the insects in a more favorable environment or from decreased effectiveness of the fumigant.

The insecticide herein reported on was a protectant dust with the formula number T-460 and consisted of pulverized wheat impregnated with 1.1 percent piperonyl butoxide and 0.08 percent pyrethrins. It is known commercially as Pyrenone Wheat Protectant. The standard recommendation for its use is 75 pounds per 1000 bushels of wheat. In this experiment a lower quantity of protectant, 50 pounds per 1000 bushels of wheat, was used so that the trends indicating the effects of the varying quantities of moisture in the wheat upon the toxic action of the insecticide could be seen more readily. It should be noted that the data presented show only the toxic properties of the protectant and do not take into account is effeciveness as a repellant.

Procedure

Thirty-two pounds of wheat of mixed varieties were slowly dried to less than 9 percent moisture. The dried wheat was divided into four lots of eight pounds each and the lots were adjusted to moisture contents of approximately

[1] Contribution No. 596 Department of Entomology. Studies conducted at the Kansas Agricultural Experiment Station under Commercial Project No. 94 using grant-in-aid funds provided by the U. S. Industrial Chemicals Co.

[2] Professor of Entomology, Kansas State College, Manhattan.

[3] Rowell, John O. the influence of moisture content of shelled corn, the fumigation temperature and the length of exposure upon the median lethal dosage of three grain fumigants on the rice weevil (*Sitophilus oryza* (L.); fam. Curculionidae). Unpublished Doctoratal Dissertation, Kansas State College, Manhattan, Kansas. 82 p., June 1950.

9, 11, 13 and 15 percent respectively. The 9-percent moisture wheat was divided into two equal parts. One part, which was to be used as an untreated check, was divided into four one-pound samples and placed in quart jars with sealed lids. The remaining four pounds were treated with 1.5 grams of protectant dust which is at the rate of 50 pounds per 1000 bushels of wheat. This treated lot of wheat was also divided into one-pound samples and placed into quart jars with sealed lids.

To each of the four treated jars and the four untreated ones were added 25 rice weevils and 25 sawtoothed grain beetles. The jars were placed in a rearing room of approximately 80 degrees F. and 75 percent relative humidity for 14 days. The insects then were screened from the wheat and the numbers of living and dead of each species were recorded. The jars again were placed in the rearing room without the insects for an additional 36 days, during which time the "hidden infestation" emerged. On the 36th day the insects were screened from the wheat and the numbers of living and dead progeny of each species were recorded.

A similar procedure was followed for the wheat samples at 11, 13, and 15 percent moisture.

Results

The extent of the toxicity of the insecticidal dust to rice weevils and sawtoothed grain beetles at 50 pounds per 1000 bushels of wheat at four different moisture levels is given in Table 1. It will be noted that both species are affected markedly by the degree of moisture present in the wheat samples.

At the 9-percent moisture level, 98.0 percent of the original infestation of rice weevils and 70.1 percent of sawtoothed grain beetles in untreated wheat were dead at the end of the 14-day period. In the treated wheat of the same moisture level, the mortality of both species was 100 percent.

At the 11-percent moisture level and in grain containing higher percentages of moisture the mortality of the rice weevils in the untreated wheat was 2.0 percent or less. Under similar conditions the mortality of the sawtoothed grain beetles was 8.1 percent or less. In treated wheat of the same moisture content, the mortality of rice weevils dropped to 93.1 percent. At 13 percent moisture the mortality dropped again to 39.4 percent, and at 15 percent moisture the mortality was only 20.0 percent.

Sawtoothed grain beetles were more susceptible to the toxicant than were the rice weevils. A mortality of 100 percent resulted at moisture levels of 9 and 11 percent, and 97.0 percent resulted at 13 percent moisture. However at 15 percent moisture a sharp drop to 55.6 percent mortality occurred.

These data readily show that under laboratory conditions with 9 percent moisture in untreated grain, the dryness prevents development and damage by rice weevils and sawtoothed grain beetles. The only progeny which developed in 9-percent moisture wheat was two sawtoothed grain beetles (Table 2). The progeny of the rice weevils increased rapidly in both treated and untreated wheat with each successive rise above the 9-percent moisture level. It should be noted that at the 14-day screening both the original insects and the protectant dust were removed from the wheat. Progeny of the sawtoothed grain beetles developed at each moisture level in the untreated wheat but did not appear until the 15-percent moisture level was reached in

the treated wheat. Thus as the moisture of the wheat is increased, the development of the weevils and the sawtoothed grain beetles is favored correspondingly.

Eleven percent moisture was favored for the development of insects in the untreated wheat, but at the same moisture wheat treated with an insecticidal dust at the reduced rate of 50 pounds per 1000 bushels produced only 3 and 4 rice weevil progeny in two of the four jars (Table 1). However, these few rice weevils were able to produce 11 and 12 progeny before the end of 14 days exposure to the wheat (Table 2).

If this breaking point at 11 percent is compared with the rapid increase in progeny at 13 percent and the very high increase at 15 percent, it is evident that high moisture permits insect development even in grain that is

Table I—The extent of survival of rice weevils and sawtoothed grain beetles when placed in untreated wheat and in wheat treated with the protectant dust T-460 at the rate of 50 lbs./1000 bu. at moisture levels if 9, 11, 13, and 15 percent.

	Wheat Untreated				Wheat Treated			
	rice weevils		sawtoothed grain beetles		rice weevils		sawtoothed grain beetles	
% moisture	alive	dead	alive	dead	alive	dead	alive	dead
9%	0	25	4	20	0	25	0	25
start	2	23	8	17	0	25	0	25
9.06	0	25	6	18	0	25	0	25
end 9.06	0	25	11	13	0	25	0	25
Total insects	2	98	29	68	0	100	0	100
Percentage	2.0	98.0	29.9	70.1	0.0	100.0	0.0	100.0
11%	23	2	23	2	0	25	0	25
start	25	0	22	2	4	22	0	25
10.81	25	0	23	2	3	23	0	25
end 11.08	25	0	23	2	0	25	0	25
Total insects	98	2	91	8	7	95	0	100
Percentage	98.0	2.0	91.9	8.1	6.9	93.1	0.0	100.0
13%	25	0	23	1	18	7	0	25
start	24	1	23	0	13	12	1	24
12.86	25	0	24	1	11	13	2	24
end 13.30	25	0	25	0	18	7	0	25
Total insects	99	1	97	2	60	39	3	98
Percentage	99.0	1.0	98.0	2.0	60.6	39.4	3.0	97.0
15%	25	0	25	0	19	6	11	14
start	25	0	20	4	21	4	15	10
14.73	25	0	24	1	20	5	11	13
end 14.86	25	0	24	1	20	5	7	8
Total insects	100	0	93	6	80	20	44	55
Percentage	100.0	0.0	93.9	6.1	80.0	20.0	44.4	55.6

partly protected with an insecticidal dust. In other words, high moisture reduced the effectiveness of insecticidal dusts as well as of fumigants.

Table II—The number of progeny of rice weevils and sawtoothed grain beetles which resulted when adults of these beetles were confined for 14 days on untreated wheat and on wheat treated with the protectant dust T-460 at the rate of 50 lbs./100 bu. at moisture levels of 9, 11, 13, and 15 percent.

	Wheat Untreated				Wheat Treated			
	rice weevils		sawtoothed grain beetles		rice weevils		sawtoothed grain beetles	
% moisture	alive	dead	alive	dead	alive	dead	alive	dead
9%	0	0	0	0	0	0	0	0
start	0	0	0	0	0	0	0	0
9.06	0	0	0	0	0	0	0	0
end 9.06	0	0	2	0	0	1	0	0
Total	0	0	2	0	0	1	0	0
11%	91	0	3	0	0	0	0	0
start	160	1	11	0	11	0	0	0
10.81	231	2	5	0	12	0	0	0
end 11.08	91	2	12	0	0	0	0	0
Total	573	5	31	0	23	0	0	0
13%	751	0	55	0	539	0	0	0
start	835	0	91	0	309	0	0	0
12.86	677	1	54	0	300	0	0	0
end 13.30	484	2	60	0	526	0	0	0
Total	2747	3	260	0	1674	0	0	0
15%	1090	0	90	0	579	0	15	0
start	531	0	39	0	747	0	25	0
14.73	1106	3	76	1	690	0	13	0
end 14.86	1141	6	132	0	832	0	25	0
Total	3868	9	337	1	2848	0	78	0

However, experience in treating wheat of high moisture content (between 13 and 15 percent) held in wooden bins in farm storage during the summer of 1952, (1), demonstrated that those bins were fully protected when protectant dusts were applied at recommended dosages. Farm storage provides conditions which permit the repellant action of the dusts to function as well as the toxic action. The results of critical laboratory tests which were conducted for the purpose of determining the effects of such variables as moisture, etc. should not be confused with practical usages of the protectant dusts.

(1) Manuscript by the author entitled "The effectiveness of insecticidal dusts containing piperonyl butoxide and pyrethrins in protecting wheat against grain-infesting insects."

Summary

Laboratory tests were set up to determine the effects of the moisture con-

tent of wheat upon the effectiveness of protectant dusts consisting of pulverized wheat impregnated with 1.1 percent piperonyl butoxide and 0.08 percent pyrethrins in killing rice weevils and sawtoothed grain beetles and in reducing the numbers of their progeny. At 9-percent moisture, survival was low for both species in treated and in untreated wheat. At 11-percent moisture, survival of rice weevils was greater and improved with each successive rise in moisture content. Sawtoothed grain beetles failed to survive successfully until the 15-percent moisture level was reached, even though the protectant dust was applied at a dosage appreciably below that recommended. The extent of the development of progeny paralleled the extent of survival of the parent stock.

THE GENERA EPIDEICTICUS, AFRODONTOMYIA, AND CYRTOPUS (DIPTERA, STRATIOMYIDAE)

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The Stratiomyidae of the Ethiopian Region, though containing many elements in common with the faunas of other parts of the world, have a large number of highly distinctive elements. The three genera treated in this paper are, with the exception of one species, *Afrodontomyia rufoabdominalis* (Brunetti), restricted to this region.

Genus *Epideicticus* Kertész, 1923

Ann. Mus. Nat. Hungarici, 20: 126-129. Type, *Nemotelus haemorrhous* Loew.

Kertész proposed this name for those species, previously referred to *Nemotelus,* in which the second antennal segment was elongated ("das erste Glied von normaler Länge oder verlängert, das zweite stets verlängert, beide zusammen gelegentlich so lang wie die Geissel"). He referred to *Epideicticus* not only the genotype and a new species, *E. imitator,* but also *N. capensis* Walker and *N. nigripennis* Bigot. Though subsequent workers have not recognized his genus, at least in the literature, I feel that it is valid. The antennal structure is strikingly characteristic and the head structure, in general, is different from at least most *Nemotelus* species. The close relationship of the two genera is, however, obvious.

Kertész thought he saw an additional difference in the venation, in that *Epideicticus* has both veins R_{2+3} and R_4 distinct, whereas *Nemotelus* lacks one or both of these. The material before me does not bear out the validity of this observation, however. The new *Epideicticus* described in this paper lacks what is apparently R_4, whereas an otherwise typical *Nemotelus* from South Africa, which I have not as yet satisfactorily determined, has both R_{2+3} and R_4 present. To base genera in the Stratiomyidae on such variable characters as the presence or absence of branches of the radius is unsafe. Kertész, of course, recognized this fact and gave these venational characters only for what he considered supporting characters.

Epideicticus hirtulus (Bigot), new combination

Nemotelus hirtulus Bigot, 1879, Ann. Ent. Soc. France (5) 9: 233.

Though Bigot made no mention of the antennal structure, his description fits quite well a male, Greenwood Park, Durban, Natal, Oct. 10, 1924 (A. L. Bevis), in the British Museum (Natural History). Bigot's types likewise came from Natal (no locality or further data given). The first two antennal segments are both elongated (ratio, 16:22, maximum widths of the two, 8 and 9 respectively); the face barely protrudes beyond the antennal bases, the eyes are very short-pilose, and vein R_4 is only very feebly developed. This species is quite similar to *E. haemorrhous* but in the male of that species the facial prominence, though very short, is better developed, and vein R_4 is quite distinct.

Epideicticus dimidiatus (Lindner), new combination

Nemotelus dimidiatus Lindner, 1935, Deut. Ent. Zeit. 1934: 311.

I have not identified this species, but Lindner's description ("Schnauze ziemlich stumpf. . . . . 2. Fühlerglied fast doppelt so lang wie das 1. und wesentlich dicker. Geissel etwa so lang wie die beiden Basalglieder") leaves little doubt but that it belongs to this genus. The abdomen is wholly yellow (female; male unknown).

Epideicticus seminfumatus, n. sp.

Female: Mostly shining black, tending to brownish black except on the thorax, clothed mostly with silvery tomentum. Front almost parallel-sided; at its lower half with a deep transverse impression, the upper part, in lateral profile, distinctly at an angle with the lower; rostellum very short, barely extending beyond the antennal bases, bluntly rounded. Tomentum densest on sides of vertex, sides of front above the depression, a spot contiguous to the eye on each side just above the antennal bases, the lower part of the face, the cheeks, and the postocular orbits except their extreme upper parts; middle of front and of facial prominence almost bare. Cheeks with a few semierect white hairs. Antenna black, as long as head; second segment distinctly the longest and slightly the thickest, at least on its apical half; fifth and sixth flagellar segments forming the style, which is contracted basally but enlarges into a broadly rounded apex which bears a small but outstanding setula. Proboscis very short, fleshy, when at rest withdrawn into the cavity of the oral margin. Comparative head measurements: head length, 74; eye to tip of rostellum, 12; antennal base to tip of rostellum, 4; antennal segments, 13: 22: 7: 6: 6: 8: 5: 10.

Mesopleura on upper part and metanotum shining, thorax otherwise densely tomentose. Humeri in part yellow. First and second segments of middle and hind tarsi bright yellow, third segment of middle and hind tarsi and the knees of the front legs brownish yellow; appressed hairs of femora, tibiae, and black parts of the tarsi brownish to black; middle femur with considerably blackish pile posteriorly. Wing distinctly, though lightly, infuscated on the basal half, to the base of the discal cell; veins of that area mostly brown; veins anterior to r-m and beyond the discal cell pale yellow, those posterior to r-m and beyond the base of the discal cell colorless. Vein R_4 wholly wanting. Halteres brown, slightly paler basally.

Abdomen with mostly scattered tomentum or appressed hairs; some semierect dark hairs toward each side of terga 1 and 2. Genitalia yellow.

Length, 4.5 mm.

Types: Holotype female, Nairobi, April, 1937 (van Someren); to be presented to the British Museum (Natural History) by the Commonwealth Institute of Entomology. Paratopotypes, 6 females, same data; paratype female, Bulanbuli, Uganda, August 19, 1929 (G. L. R. Hancock). Also, 5 topotypical females in damaged condition.

This species is much like *haemorrhous* (Loew) in appearance, but the rostellum is much shorter, the abdomen is not reddish apically (though the genitalia are yellow), vein R_4 is wanting, and the wing is infuscated basally. This combination of characters, particularly the last two, will distinguish this species likewise from any other *Epideicticus* known to me either through examination or from the descriptions.

Genus *Afrodontomyia* James, 1940

Amer. Mus. Nov., 1088, p. 1. Type, *Odontomyia seminuda* Curran.

Four species, *seminuda* (Curran), *gracilis* (Curran), *protrudens* (Curran), and *rufoabdominalis* (Brunetti) were originally included in this genus. In addition to these, *Odontomyia gigas* Brunetti, *Odontomyia impressa* Curran, and the species described below as *titan*, new species, seem to form a homogeneous group which may best be referred here. An additional and more typical species is also being described in this paper.

Key to Species

1. Very large species, 20 mm. or more in length; front of female clothed with short peg-like or scale-like setulae; scutellum with a preapical impression along its median line; abdomen clothed with tawny or golden tomentum 2
   Smaller species, not over 15 mm. in length; front of female with only ordinary hairs; scutellum without a preapical impression along the median line 4
2. Tibiae in part yellow; mesonotum laterally with same pale pile 3
   Legs black, at most the tarsi appearing somewhat reddish or brownish; mesonotum black-tomentose, without erect pile, the very short lateral semierect pile being likewise black ..... *titan*, n. sp.
3. Abdomen green, immaculate in the male, black toward the apex in the female; scutellar spines green ..... *impressa* (Curran)
   Abdomen reddish, the second to fourth terga each with indefinite brownish areas basally, the sterna each with a large black spot; scutellar spines black at base, thence bright reddish above, yellow below ..... *gigas* (Brunetti)
4. Abdomen entirely reddish 5
   Abdomen conspicuously marked with black 7
5. Mesonotum with abundant, though short, erect black or blackish pile; abdominal sterna with abundant golden appressed or semierect pile, especially on the middle of the first three segments 6
   Mesonotum and abdominal sterna practically without erect pile ..... *seminuda* (Curran)

6. Pile of head, except vertex, and of pleura silvery; first two antennal segments shining black; hind legs wholly reddish yellow ..... *apicalis*, n. sp.
   Pile of head, largely, and of pleura yellow; antennae reddish brown; hind legs largely black ..... *gracilis* (Curran)
7. Base of abdomen, that is, at least the first three segments, yellowish green; the apex without bright reddish pile ..... *protrudens* (Curran)
   Base of abdomen black, the apex reddish, with bright reddish pile ..... *rufoabdominalis* (Brunetti)

Afrodontomyia impressa (Curran), new combination

Odontomyia impressa Curran, 1928, Amer. Mus. Nov., no. 324, p. 1; James, 1940, Amer. Mus. Nov., no. 1088, p. 1.

Eulalia impressa (Curran), Lindner, 1938, Bul. Mus. Roy. d'Hist. Nat. Belg., 14 (54): 19.

Afrodontomyia titan, n. sp.

Female: Head reddish brown. Front and face almost parallel-sided; a pair of oval shining calli above the antennal bases; above these, two poorly defined depressions; vertex prominently convex; face with a strongly rounded keel, prominent, though not projecting, below the antennal bases, thence retreating gradually to the oral margin. Vertex and front above the calli rather thickly beset with short peg-like or scale-like setae which merge into a more usual type of setae on the vertex and ocellar triangle. A patch of silvery tomentum on each inner ocular orbit opposite the antennal bases and another similar patch on each side of the lower part of the face; pile of face otherwise very scattered, pale, that of the cheeks and occiput rather abundant, short, black; postocular orbits very narrowly silvery pruinose and more broadly black tomentose. Proboscis shining black. Antenna black and black-haired; first and second segments shining, first twice as long as wide, twice as long as second; flagellum dull, only its first three segments preserved in the type.

Thorax brownish, the pleura becoming blackish; mesonotum densely black tomentose, without erect pile, pleura black pilose, the pile thick but very short; scutellum reddish, mostly yellow-pilose, narrowy brownish and black-haired at base, the spines narrowly black-tipped. Legs black with short black hairs; tarsi reddish, ventrally with dense short tawny pile. Halteres brown, the knobs green. Wings pale brown, the infuscation lighter posteriorly; R_4 present; r-m and m-cu short but distinct.

Abdomen bright red; first three sterna except broad margins brownish; tomentum dense, golden, that on dark ventral areas in part reddish to blackish.

Length, 22 mm.

Holotype female, Kenya Colony, 1939, D156, (C. B. Symes); to be presented to the British Museum (Natural History) by the Commonwealth Institute of Entomology.

Afrodontomyia apicalis, n. sp.

Male: Eyes contiguous for one-fourth length of front; frontal triangle long and acute. Face projecting forward slightly below eyes, thence receding to the oral margin. Head brown, face becoming black laterally. Ocellar tri-

angle and upper part of occiput with short black hair; pile and tomentum of head otherwise silvery; an upper frontal tuft, a tuft on the frontal triangle, and one on each side of the face contiguous with the eye, outstanding. Proboscis mostly black and shining; palpi reddish, white-haired. First antennal segment four times as long as wide and twice the second, black; flagellum missing in the type.

Thorax brownish black, mesonotum becoming reddish before the scutellum; scutellum reddish at the base, yellow broadly on sides and apex, including the spines. Pile of mesonotum mostly reddish brown and black; that along the anterior margin and sides, as well as on the pleura, white; that of the scutellum reddish brown at base, yellow at apex. Anterior and middle legs with coxae black, femora reddish brown, on the basal half reddish yellow, tibiae reddish brown with a narrow reddish yellow median annulus, and tarsi dark reddish yellow; hind leg including coxa reddish yellow. Wing strongly brown-infumated, the extreme tip suddenly paler; R_4 present; r-m and m-cu of moderate length. Halteres reddish yellow, the knobs pale green.

Abdomen unicolorous, reddish yellow with golden tomentum; some erect paler hairs at base.

Length, 13 mm.

Holotype male, Afon, Nigeria, April 19, 1937 (F. D. Golding); to be presented to the British Museum (Natural History) by the Commonwealth Institute of Entomology.

Genus Cyrtopus Bigot, 1883

Bull. Ent. Soc. France, 1883, p. xcvi. Type, *C. fastuosus* Bigot.

This genus can readily be recognized by the flattened front tibia and basitarsus and by the highly metallic, squamose, appressed vestiture of much of the thorax and abdomen and parts of the head; in the two known species, these scales are blue, purple, or bluish green. The antenna is close to the *Eulalia* type; the style, however, is very small, its first segment being hardly noticeable, so that the flagellum may appear to have only five segments. The wing venation is fairly strong, the vein M_3, however, being weak.

Cyrtopus smaragdiferus (Lindner), new combination

Eulalia smaragdifera Lindner, 1938, Mitt. Deut. Ent. Ges., 8:70.

This is a typical *Cyrtopus* and structurally close to the genotype; the black head of *smaragdiferus* will easily distinguish it from *fastuosus,* which has a reddish-yellow head. Lindner described his species from one female from Nyassaland. I have seen a female from Tanganyika Ty., Morogoro, May, 1922 (A. H. Ritchie), in the British Museum (Natural History), which agrees with Lindner's description. In this specimen, the yellowish-white spots of the venter are arranged in three series, one located medially and one on each side, one set of three to a segment.

NEW SPECIES OF MELOIDAE FROM UTAH (Coleoptera)

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This paper presents descriptions of two new species discovered during a study of the Utah Meloidae undertaken by the writer as a graduate student in the Department of Invertebrate Zoology and Entomology of the University of Utah. A grant provided by the University of Utah Research Committee, which made possible the study of the material described, is gratefully acknowledged.

Zonitis hesperis, n. sp.

Body robust. Color fulvous, antennae, maxillary palpi, last segment of labial palpi, elytra, greater part of femora, entire tibiae, and tarsi, except bases of metathoracic tarsi, piceous. Pubescence pale, short, suberect, and sparse on head, pronotum, and elytra, longer, denser, and subrecumbent on labrum, clypeus, rest of thorax, and abdomen. Length 8-8.5 mm.

Female: Head short, length, exclusive of labrum, slightly greater than breadth at tempora; surface smooth, feebly and very sparsely punctate; frons flat; maxillae with galeae lobiform, extending just beyond mandibles; antennae filiform, slender, about two and four-fifths times as long as prothoracic tibia, second segment three-fourths as long as first, third subequal in length to first, fourth slightly longer than third; eyes small, lateral, about one and three-fourths times as long as broad, clearly less than half as broad as frons between eyes. *Thorax,* except pronotum, finely and sparsely punctate; pronotum large, transverse, one and one-fifth times as broad as long, broadest just before middle, weakly narrowed posteriorly, strongly narrowed near apex, surface smooth, subimpunctate; elytra feebly rugose, without distinct punctures. *Legs* with metathoracic tibial spurs moderately thick, subequal in length, inner spur flattened, stick-like, outer spur stouter than inner, ob-

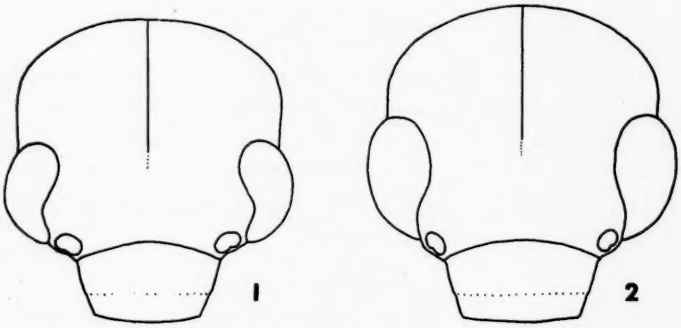


Fig. 1. *Epicauta lupini,* cephalic aspect of head capsule.
Fig. 2. *Epicauta sericans,* cephalic aspect of head capsule.

liquely truncate; tarsal claws with five or six dentes in inner row. *Abdomen* finely and sparsely punctate; sixth sternite truncate or shallowly emarginate.

Male: Unknown.

Holotype female and *paratype* female: Wild's Ranch, Hill Creek, Uintah Co., UTAH, 6000 ft., August 5 & 6, 1937, G. E. Wallace (Carnegie Museum).

This species most closely resembles *Z. vermiculata* Schaeffer, a species described from southwestern Utah. It differs principally in having the body much more robust, antennae shorter, elytra without a purplish tint, piceous color of femora not limited to the apices, and tarsal claws with fewer dentes in the inner row.

The writer is indebted to Dr. George E. Wallace, of the Carnegie Museum, for his kindness in loaning the specimens described above.

Epicauta lupini, n. sp.
(Fig. 1)

Color black. Surface densely clothed with recumbent, unicolorous, cinereous or olive-cinereous pubescence. Length 5-10.5 mm.

Male: Head subquadrate, about one and one-tenth times as broad as pronotum, length, exclusive of labrum, slightly greater than breadth at tempora; tempora broadly rounded, not prominent; surface minutely granulate, finely and densely punctate; median impressed line distinct from vertex to level of eyes; frons with a shallow impression on each side near eyes; eyes rather small, moderately prominent, narrowly suboval, at least two and one-fourth times as broad as frons between eyes; antennal calli small, pubescent; antennae filiform, not tapered apically, a little more than twice as long as prothoracic tibia, first four segments in part cinereous-pubescent, first segment reaching one-third distance across eye, second half as long as first, third subequal in length to first, fourth to tenth subequal in length, about two-thirds as long as third, longer than broad, eleventh subequal in length to third. *Pronotum* campanulate, varying from slightly longer than broad to slightly broader than long; sides parallel for posterior two-thirds, then moderately convergent to apex; disk gently declivous and flat or very shallowly concave from just behind middle to apex, moderately robust behind, with a broad flattened area on each side and a broad median impression at base; midline, at least on posterior two-thirds, smooth, glabrous, occasionally shallowly impressed. *Legs* with prothoracic tibiae not modified, with two spiniform spurs; metathoracic tibial spurs long, slender, spiniform, outer spur occasionally slightly broader than inner; tarsi in part cinereous-pubescent on outer side, claws straight for basal half.

Female: Similar to male.

Holotype male and *allotype* female: Kimballs Junction, Summit Co., UTAH, 6900 ft., on *Lupinus* sp., July 16, 1950, R. B. Selander (University of Utah). *Paratypes:* 26 adults, same data; 31 adults, same data, July 4, 1950; 9 adults, same data, August 7, 1950; 2 adults, same data, July 10, 1951.

This species belongs in the BB group of Werner's table of species (Bull. Mus. Comp. Zool. 95(5):424-425; 1945). It keys to couplet 85 of his key (*op. cit.*:426-435). From both *E. sericans* LeC. (Fig. 2) and *strigosa* (Gyll.) *lupini* differs in having the eyes narrower and less prominent, metathoracic tibial spurs slender and spiniform, not in the least stick-like, and pronotal

disk distinctively contoured. In addition, it differs from the former species in having the pronotum smaller and narrower and the tarsal claws clearly not curved from the base, and from the latter in having denser pubescence, which is always unicolorous.

A NEW GENUS AND SPECIES OF CHIGGER MITE[1] [2] (ACARINA, TROMBICULIDAE)

LOUIS J. LIPOVSKY
Lawrence, Kansas

Among the subfamily Trombiculinae in which there are only three scutal setae, the genus *Ascoschöngastia* Ewing (1946) has sensillae which are expanded distally; the genera *Tecomatlana* Hoffmann (1947), *Sauriscus* Lawrence (1949), and *Trisetica* Traub and Evans (1950) have sensillae which are essentially flagelliform. On the basis of the sensillae the genus here described apparently falls in the group of genera having flagelliform sensillae, although upon casual examination they appear expanded distally. The position of the posterolateral setae off the scutum apparently arose independently in each case; it also occurs in a few genera of the subfamily Walchiinae.

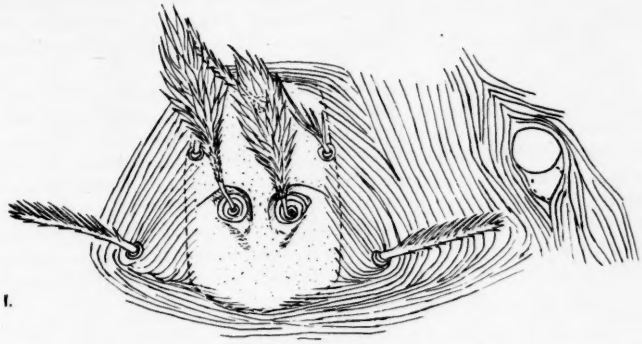
Speleocola new genus

Diagnosis: This genus differs from the other genera of the Trombiculidae in that the sensillae are presumably flagelliform but covered with numerous, basally expanded setules which obscure the true nature of the stem. In addition, this genus differs from any known genus in the shape of the scutum, the true outline of which is obscured by the attachments of the dermal striae, making it difficult to ascribe positive margins. The peculiar pattern of striation surrounding the posterolateral setae and their attachment on the scutum, on occasion, leaves one to speculate as to the existence of a subdermal scutal bridge which may bear the posterolateral setae. Although this genus has a

[1] Contribution No. 796, Department of Entomology, University of Kansas.
[2] The studies upon which this paper is based were conducted under a contract, N6 ori 220 Task Order II, between the University of Kansas and the Office of Naval Research.

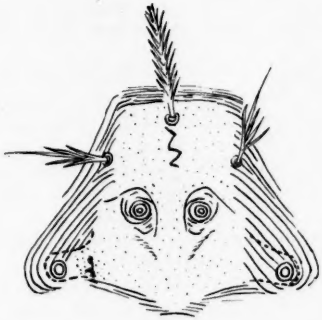
EXPLANATION OF PLATES
Plate I
Speleocola tadaridae new genus and species

Fig. 1. Apparent shape of scutum and right eye.
Fig. 2. Scutum with possible PL connectives. Zig-zag suture below AM is usually present.
Fig. 3. Aberrant coxa II seta.
Fig. 4. Anterior sternal seta, lateral aspect.
Fig. 5. Anterior sternal seta.
Fig. 6. Humeral seta.
Fig. 7. Sensilla; magnification doubled.
Fig. 8. Probable stem of sensilla; magnification doubled.



1.

50 μ



2.

3. 4. 5. 6. 7. 8.

3-pronged palpal claw as does *Trisetica,* the prongs differ in shape and size; two of them are fine and needle-like, and generally one of these may be overlooked. Superficially, it appears most closely related to *Trombicula sensu lato,* even though the sensillae and scutum are very different from those of *Trombicula.*

Description: Three scutal setae (posterolateral setae may be on the scutum subdermally), anteromedian seta above level of anterolateral setae; anterolateral setae with basal branches, anteromedian seta similar to posterolaterals. Distal portions of sensillae clothed with broadly expanded setules which terminate in slender filaments, setules continue more than half way down the stem diminishing in size below the middle; proximal portions nude. Palpal claw with very prominent middle prong, two short lateral prongs about equal, minute, needle-like. Posterior eyes weak and obscure. Empodium claw-like.

Type species: Speleocola tadaridae new species. No other species known.

Speleocola tadaridae n. sp.

Body: Striae moderate. Length and width of holotype, engorged, 412 by 256 microns. Body widest at level of coxae III. Color in life pale yellow to yellow-orange. Eyes 8 to 10 microns in diameter, 1/1, posterior eyes and ocular plate obscure, eyes red in life. Anus situated at the level of the sixth row of ventral setae.

Gnathosoma: Base of chelicera slightly longer than broad, with few punctae. Blade of chelicera with two or three terminal teeth. Seta on palpal coxa, femur, and genu branched; tibia with nude dorsal and lateral setae, ventral seta with one basal branch. Palpal claw trifurcate, middle prong largest. Palpal tarsus with six setae, four branched, two nude, dorsal seta prominent and many branched; spur about five microns in length. Galeal seta nude.

Scutum: Very small, punctae fine and scattered, dermal striae attached on poorly defined margins. Shape roughly rectangular, elongate on anteroposterior axis. Anterolateral setae with basal branching, not longer than and frequently shorter than the anteromedian seta. Sensillae unique, setules broad and tapering, terminating in slender filaments, diminishing in size to small barbs proximally, bases of sensillae nude. Scutal measurements of holotype: AW-26, PW-50, SB-11, ASB-21, PSB-21, AP-23, AM-23, AL-21, PL-26, S-40. The average scutal measurements of 9 paratypes, slides 6702-6710: AW-26, PW-50, SB-11, ASB-23, PSB-19, AP-26, AM-22, AL-19, PL-26; the average length and width of these specimens are 403 by 253 microns.

Legs: All segments of all legs finely and uniformly punctate. Leg I coxa with a single branched seta; trochanter and basifemur each with a straight branched seta; telofemur with 5 branched setae; genu with 4 branched setae, 3 genualae and a microgenuala; tibia with 8 branched setae, branches on these

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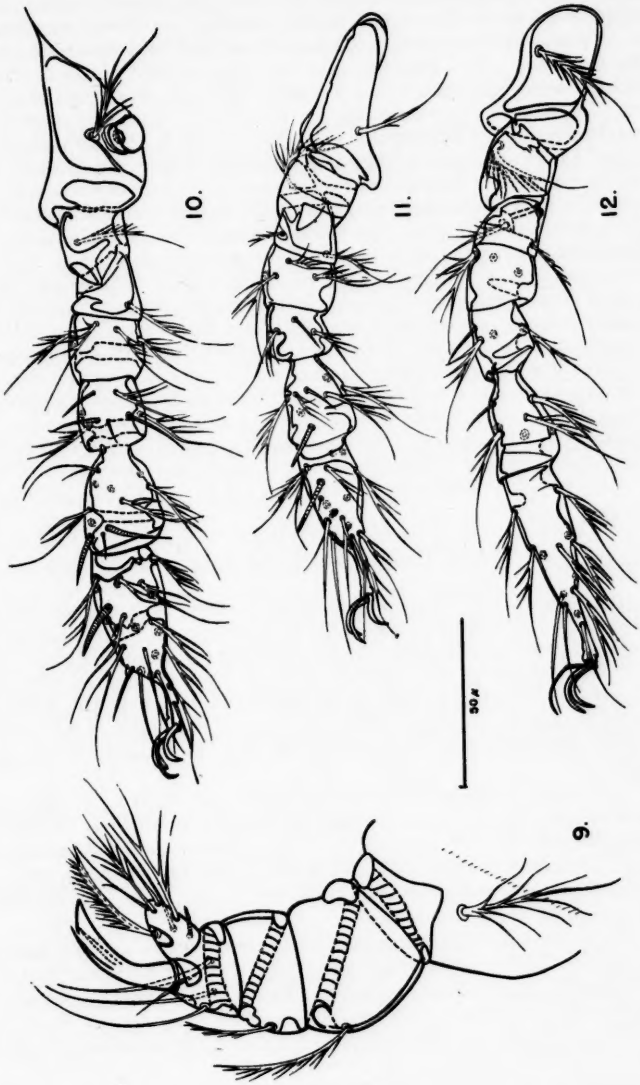
Plate II

Speleocola tadaridae new genus and species

Fig. 9. Palp; magnification doubled.
Fig. 10. Leg I.
Fig. 11. Leg II.
Fig. 12. Leg III.


10.
11.
12.
50 μ
9.

varying from 1 to 8 or more, and about 3 nude setae, a spur, a microspur, a parasubterminala, a subterminala, and a pretarsala. Leg II coxa with a nude seta or frequently with two basal branches; trochanter with curved branched seta; basifemur with 2 branched setae (one diminutive); telofemur with 4 branched setae; genu with 3 branched setae, 1 genuala; tibia with 5 branched setae, 2 tibialae (one approximating size of tarsal spur); tarsus with about 13 branched setae (one to several branches), in addition, about 4 nude setae, a spur, a microspur, and a 2 branched seta where the pretarsala should be. Leg III coxa with a branched seta; trochanter with a curved branched seta; basifemur with 2 branched setae (one with smaller branches); telofemur with 3 branched setae; genu with 3 branched setae and a genuala; tibia with 6 branched setae and a tibiala; tarsus with 13 setae two of which are nude.

Setae: Dorsal setae about 55, not including 2 pairs of humerals; first 2 rows of dorsal setae irregular; dorsal setae, except in posterior rows, similar to anteromedian, posterolateral, and humeral setae. Ventral setae 2-2 plus about 46, and in addition, 2 setae between coxae II and III. Some setae in region of anus without long branches, or nude; majority of ventral setae appear frayed or with short barbs only. Sternal setae with obvious basal branching, with only about 2 pairs of branches. In holotype, measurements of anterodorsal and ventral setae 21, first and second sternals 30 and 25 respectively, humeral 29, and coxa II seta 28 microns. Paratype, slide number 6707, coxa II seta with a filamentous branch arising at base and a shorter branch and barb below middle.

The basal-type branching of many of the body setae is also characteristic of most of the setae of the appendages and the anterolateral setae of the scutum.

Type material: Holotype and 49 paratypes from the Merrihew Cave in Woods County, Oklahoma, 6 miles south, 2 miles west of Aetna, Kansas, on *Tadarida mexicana* (Saussure), Mexican free-tail bat; holotype slide number 6701, and paratypes, slide numbers 6702-12 (field number RL490824-2), August 24, 1949, hosts collected by Richard B. Loomis, Robert E. Elbel and David T. Clark; paratypes, slide numbers 6713 to 6750 (field number RL480915-4), September 15, 1948, collected by R. B. Loomis and L. J. Lipovsky.

Disposition of types: Holotype and a series of paratypes of *Speleocola tadaridae* are deposited in the Snow Entomological Museum. Additional paratypes will be distributed to the United States National Museum, the Rocky Mountain Laboratory, Duke University, the British Museum (Natural History), the Museum National d'Histoire Natural, Paris, and the South Australian Museum, Adelaide.

Remarks: Additional specimens with the same locality and host data but not included in the type series are: slide numbers 6751 to 6793 (RL480915-4); 6794 to 6798 (RL490824-2), and 6799 (RL511006-4). Other species of bats taken in the Merrihew cave were not parasitized by *Speleocola.* From over 250 *Tadarida* taken in 1948, 1949, and 1951, about 200 larvae of this species of chigger were recovered.

Biological note: This species of chigger was found only in the ears of its host. It was found in association with an undescribed species of larval trom-

biculid, also in the ears. These two species are extremely difficult to distinguish or separate for culture purposes. Nymphs of *Speleocola* have been reared from engorged larvae and will be described elsewhere.

SEASONAL DEVELOPMENT OF CATTLE GRUBS IN WYOMING[1]

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Information on the seasonal occurrence of cattle grubs, *Hypoderma lineatum* (DeVill.) and *Hypoderma bovis* (Deg.), in the backs of cattle was obtained at three different locations in southeastern Wyoming. The methods used in obtaining this information were the following: The backs of dairy cows (Holstein, Guernsey, and mixed) were examined at approximately weekly intervals, except at times when the intervals were extended up to 14 days because of impassable roads. Whenever the symptoms of a grub's arrival in the back were discovered, the location was marked by clipping a small amount of hair near the breathing hole and entering the position of the grub with a designated number on a map of the cow's back. The species of grubs were determined by looking through the holes at the structure of the posterior stigmal plates and also by taking samples of grubs from the backs of certain cows and examining them in the laboratory. The procedure of following the development of individual grubs was carried out at Laramie in 1944 and at Wheatland in 1949 and 1950. Only the recording of the total number of grubs in a cow's back at approximately weekly intervals along with the taking of samples of grubs was made at Laramie in 1945 and 1946, at Cheyenne in 1945, and at Wheatland in 1948. The dates of events in the seasonal cycle of grubs were calculated as occurring midway between examination dates.

A limited number of Herefords were also examined but at irregular intervals.

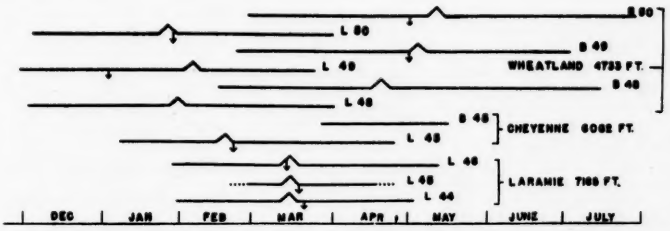

Fig. 1. Seasonal presence of cattle grubs in the backs of cattle. L. designates *H. lineatum;* B, *H. bovis.* Arrows indicate first emergence, raised lines indicate maximum numbers.

[1] Published with approval of the Director, Wyoming Agricultural Experiment Station, as Journal Paper No. 16.

Results: The first appearance of common grubs (*H. lineatum*) in the backs of cows occurred around December 1 at Wheatland, January 7 at Cheyenne, and February 1 at Laramie. The variations in arrival were presumed to be related to the altitudinal and climatic differences of the three locations and not to the different years in which the data were obtained. An average difference of 25 days for each 1000 feet of altitude was indicated, while less than a week's variation in arrival was found for different years at any one location.

The peak in numbers of grubs in the backs occurred in the same chronological order as the order of first arrivals. Peaks occurred at Wheatland around February 1, at Cheyenne around February 17, and at Laramie around March 15. The total spread of the peaks at the different locations was somewhat less than that of the first arrivals.

Common grubs began to emerge or drop from the backs during January at Wheatland, the last part of February at Cheyenne, and around the middle of March at Laramie (Fig. 1 and Table 1). Here the assumption was made that the disappearance of a grub between examinations of cows indicated that the grub had matured and left the cyst to pupate on the ground; but this assumption might not be true, for the grub may have died and disappeared in some other way. Such a fate may possibly have happened to the apparently early maturing grubs at Wheatland. In general few common

Table 1. Seasonal development of cattle grubs in the backs of cattle in Wyoming.

	H. lineatum			*H. bovis*	
	Wheatland		Laramie	Wheatland	
	1950	1949	1944	1950	1949
Number cattle	3	18	6	14	18
Number grubs	29	124	32	37	72
First appearance	Dec 5	Nov 28	Jan 31	Feb 28	Feb 22
Last apparance	Mar 1	Feb 22	Apr 4	May 29	May 20
First emergence	Jan 30	Jan 4	Mar 21	May 1	May 1
Last emergence	Apr 1	Mar 25	May 3	July 29	July 4
Spread of appearance in days	86	86	64	90	87
Spread of emergence in days	61	80	43	89	64
Period of species presence in back, days	117	117	93	153	132
Minimum developmental pd in back, days	38.5	36.0	36.0	40.0	45.5
Maximum developmental pd in back, days	85.5	89.5	85.5	123.5	94.5
Mean developmental pd in back, days	59.3	53.5	49.1	66.7	67.9
Mean developmental pd early grubs, days*	61.4	58.0	49.4	72.6	71.8
Mean developmental pd late grubs, days**	55.7	51.2	48.8	56.6	63.0
Difference between early and late, days	5.7	6.8	0.6	16.0	8.8

*Grubs appearing during first two calendar months of arrival period.

**Grubs appearing during last two calendar months of arrival period.

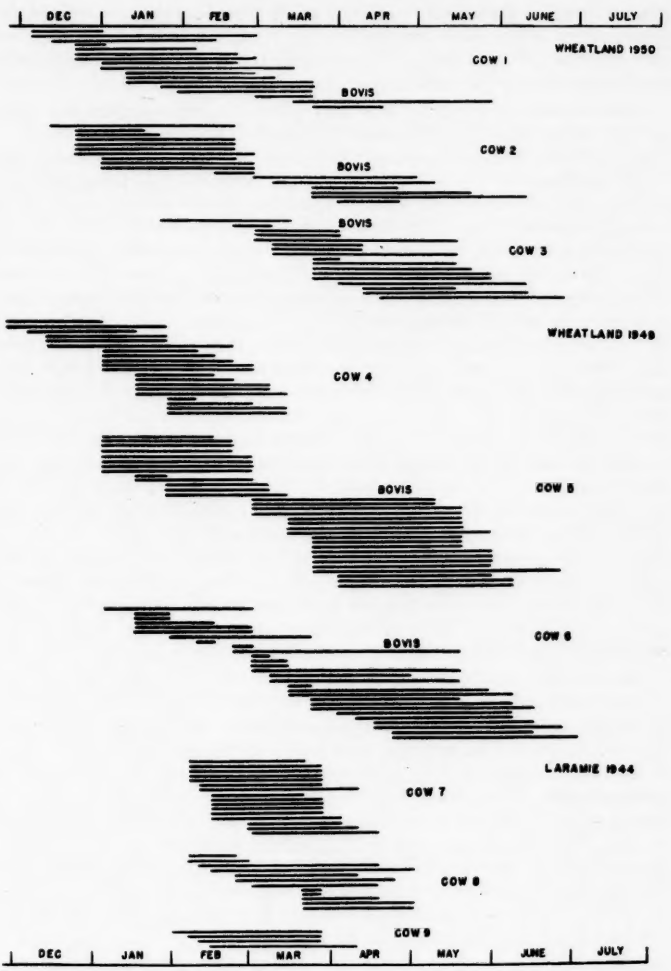

Fig. 2. Sample data on the seasonal history of grubs in the backs of individual cows. Each line represents the time of development of a single grub. *H. lineatum* represented by top or all lines of graph for each cow; *H. bovis* represented by bottom lines under designation bovis.

grubs emerged sooner than 45 days after the first seasonal presence of this species in the backs. None dropped at Laramie in 1944 before 49 days had passed; none at Wheatland in 1950 before 56 days; and none at Wheatland in 1949 before 37 days and only 1.3 per cent before 47 days.

The duration or length of time that common grubs were present in the backs of cattle was 121, 117, and 117 days at Wheatland during the years 1948, 1949, and 1950, respectively; 108 days at Cheyenne in 1945; and 94 and 99 days at Laramie in 1944 and 1946, respectively. No individual grubs, of course, were present these lengths of time. The periods of time occupied by individual grubs in the backs of cows are shown in Table 1. The average lengths of time spent by common grubs in the backs were: Laramie 49.1 days in 1944; Wheatland 53.5 days in 1949 and 59.3 days in 1950. Graphs of the occurrence of grubs in the backs of three cows from each locality are shown in Figure 2. In calculating average periods in the backs, short periods, (less than 35 days for the common grub and less than 40 days for the northern grub) were not included, as the assumption was made that the grubs represented by the short lines had died before reaching maturity. This does not necessarily imply that all grubs going over these minimum times survived to maturity, for in a few cases grubs which had nearly reached maturity were found dead. However, the majority apparently survive and complete their development in the backs of the hosts, as was indicated by the results of placing coats around seven cows to collect grubs for laboratory and field testing. Whether the common grub is able to reach maturity in less than 35 days and the northern in less than 40 days could not be determined by the methods used in this study. Bishopp *et al.* (1926) recorded a minimum period of development of 39 days for the common grub and 65 days for the northern grub, while Scharff (1950) has recorded a minimum period of 36 days for the common grub and 42 days for the northern grub.

Information on the seasonal development of the northern grub (*Hypoderma bovis*) in the backs of cattle was obtained in more or less detail only at Wheatland, for none of this species was found at Laramie and merely a few at Cheyenne. The northern grub made its first appearance in the backs of cows at Wheatland during the last half of February, 12 weeks after the common grub. The peak numbers occurred about 70 days later during the last of April or first of May. Emergence of grubs began May 1 and ended in July. The average length of development of individual grubs in the backs of cattle was 67 days in 1950 and 68 days in 1949. The total length of time this species was present in the backs of cows was 150 days in 1948, 132 days in 1949, and 153 days in 1950. These and other data on the northern grub are found in Figs. 1 and 2 and Table 1.

Discussion: A notable amount of variation in the occurrence of events in the seasonal cycle of grubs in the backs of cattle is evident not only among the foregoing data but also among the data published by Bishopp *et al.* (1926), Scharff (1950), and others. Apparently the first appearance of common grubs in the backs of cattle varies with altitude, since the data show an average of 25 days' delay in appearance of common grubs with each 1000 feet increase in altitude, the data of Smith *et al.* (1941) for Colorado show 21 days, and those of Shull *et al.* (1945) for Idaho, 25 days. Scharff's data, how-

ever, indicate that the date of grub appearance cannot be correlated in all instances with elevation. He suggests with good reason that variations in appearance may result from climatic variations independent of altitude, such as the nature, the exposure, and the slope of soils in which the pupae transform to adults.

Variations in first appearance of northern grubs occur which can be similarly correlated with altitude. There was a difference of 26 days per 1000 feet between Wheatland and Cheyenne; Scharff found differences of 23 to 28 days per 1000 feet in Montana except in one comparison where a variation of 30 days obtained with only a difference of 50 feet in altitude.

The period between the first appearance and the first emergence is apparently quite variable, in spite of the fact that these two events should be closely correlated with each other. The present data show that this interval for the common grub ranged from 37 to 56 days; Scharff's data show 41 to 70 days; and Bishopp's data show 42 to 52 days. For the northern grub this interval was longer but less variable, as the data from Wheatland revealed the period to be 62 and 68 days and Scharff's data in Montana 62, 69, 69, and 86 days.

The occurrence of peak numbers of grubs in the backs of cattle and the interval between first appearances and the peaks are of great interest in scheduling control treatments. Unfortunately this interval exhibits much variation among different regions, for the interval of the common grub ranged from 40 to 45 days at Laramie and 52 to 68 days at Wheatland, while Scharff found that it ranged from 38 to 55 days in Montana and Bishopp *et al.* from 82 to 98 days in Texas. The same interval for the northern grub ranged from 65 to 72 days at Wheatland, from 81 to 90 days in Montana (Scharff), and a calculated 70 days in New York (Bishopp *et al.*). The interval between the peak of the common grub and the peak of the northern grub also seems to vary a great deal in different areas, for at Wheatland it ranged from 80 to 105 days, whereas in Montana it ranged from 57 to 61 days.

Another point of economic interest is the relation of the time of the last arrival of a grub in the backs of cattle to the time of first emergence. In Wyoming a small number of common grubs appeared after the first emergence, but in Montana Scharff found that the last grubs to appear arrived either before or at the same time as the first emergence. The northern grub in both Wyoming and Montana started emergence before the last grub appeared, although in Montana data on one herd showed that the last appearance and the first emergence coincided, while data on another herd showed that the last appearance occurred before the first emergence.

The year-to-year variations of seasonal events in individual localities usually are not very great, as common grubs for three years made their first appearance at Wheatland within a 5-day period and their peak in numbers occurred within a 9-day period. The first appearances and peaks of the common grub were even closer together at Laramie, being 3 days and 1 day, respectively. Bishopp *et al.* (1926) found the dates of first appearances at Dallas, Texas, in 10 different years to be rather uniform, for with one exception there was a spread of only 20 days. They also found uniformity in New York state. In Montana Scharff (1950) found the first appearances of

the common grub in 1948 and 1949 to differ by 3 days in one herd and by 16 days in another. That wider variations may occur and do occur in some years have been noted by Scharff and by Bishopp *et al.* Variations in the events of the life cycle of the northern grub from season to season also appear to be relatively small, for during three seasons at Wheatland there was a spread of only 11 days among the first appearances and 22 days among the peaks.

The proper scheduling of treatments is one of the complex and still inadequately solved problems of cattle grub control. A number of writers have made recommendations recently which have ranged from two treatments a season to approximately 15 treatments. In deciding the number of treatments to be made, three important factors should be taken into account: (1) effect of treatments on management practices and on health and growth of animals, (2) the number of treatments required to obtain successful control, and (3) the cost of treating in relation to the financial gain (or possibly in some cases the losses) derived from control. Additional research and information is needed on all of these points to permit the formulating of a scientifically sound recommendation; but from an analysis of presently available information, this writer suggests that three or four treatments are needed in the northern Rocky Mountain states where both common and northern grubs exist. More than one treatment is suggested for each species because of the difficulties involved in exactly timing treatments to hit the peaks or maximum numbers and because currently recommended insecticidal applications provide less than 100 per cent kills. Less than eight treatments for each species is suggested because this large number would interfere with management practices, would cost about four times as much, and seems unnecessary for killing close to 100 per cent of the grubs. On the basis of the data presented by Scharff (1950) for Montana and by the present writer for Wyoming, a schedule of treatment which takes consideration of the seasonal development in the backs and also the seasonal and regional variations would be the following: Apply four treatments, the first 45 days after the first appearance of grubs, the second 30 days later, the third 45 days later, and the fourth 30 to 45 days later if grubs are still present. If this schedule is followed the first treatment would be made either before any grubs have dropped or at the latest after only a few have dropped, the second treatment would hit common grubs escaping the first treatment or appearing in the backs after the first treatment was made and in some herds it would also hit early appearing northern grubs, and the third and fourth treatments would hit northern grubs. A few late appearing northern grubs may be missed as they would arrive in the backs after the last treatment. In following this schedule at Wheatland during the years 1948 to 1950, the treatments would have been made on the following approximate dates: (1) January 15, (2) February 15, (3) April 1, and (4) May 1 to 15. Robb (1952) has suggested a schedule of treatments that begins 40 days after the first appearance of grubs and continues at 40-day intervals during the period of infestation in the backs. This schedule appears to be a well timed one, but if followed would include a fifth treatment in some areas, *e.g.* Wheatland. It seems that little loss in effectiveness of the schedule would result if the fifth treatment were dispensed with.

The importance of the late treatments in both schedules can not be overemphasized as they are designed to control the northern grub, which is a more injurious pest than the common grub. Errors in both recommendations and in actual control practices have been made in Wyoming during past campaigns because two or sometimes three applications were advised and carried out early in the cattle grub season while late applications were neglected. The early schedules allowed satisfactory control of the common grub but gave practically no control of the northern grub.

Finally, it should be mentioned that more seasonal history data from other areas are needed on cattle grubs because of the relation of proper timing to successful control. Future investigations will determine how generally the above two recommended schedules can be applied in the northern Rocky Mountain region.

Summary

Observations on the seasonal occurrence of cattle grubs in the backs of cattle were made at three different locations in southeastern Wyoming. The first seasonal appearance of common grubs, *Hypoderma lineatum* (DeVill), occurred around December 1, peak numbers were attained 45 to 60 days later, and the total duration of this species in the backs of cattle ranged from 93 to 121 days. The first seasonal appearance of the northern grub, *Hypoderma bovis* (Deg.), occurred during the latter part of February, 12 weeks after the common grub; peak numbers were attained about 70 days later; and the total duration of grubs in the backs ranged from 132 to 153 days. Seasonal events in the life cycles were delayed at locations of higher elevation. The average developmental period of grubs in the backs of cattle was 54 days for the common grub and 67 days for the northern grub. From an analysis of the available information on seasonal presence of grubs in the backs of cattle, and of the seasonal and regional variations, a control schedule for the northern Rocky Mountain states is suggested that is comprised of four treatments spaced at intervals of 45-30-45-30 to 45 days from the date of the first seasonal presence of grubs in the backs.

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A NEW SPECIES OF NOMADOPSIS (Hymenoptera, Andrenidae)

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The description of this species is being published in advance of a forthcoming revision of the genus *Nomadopsis* in order that Dr. C. D. Michener may be able to refer to the larva of the species in a paper he is about to publish.

Nomadopsis fracta Rozen, n. sp.

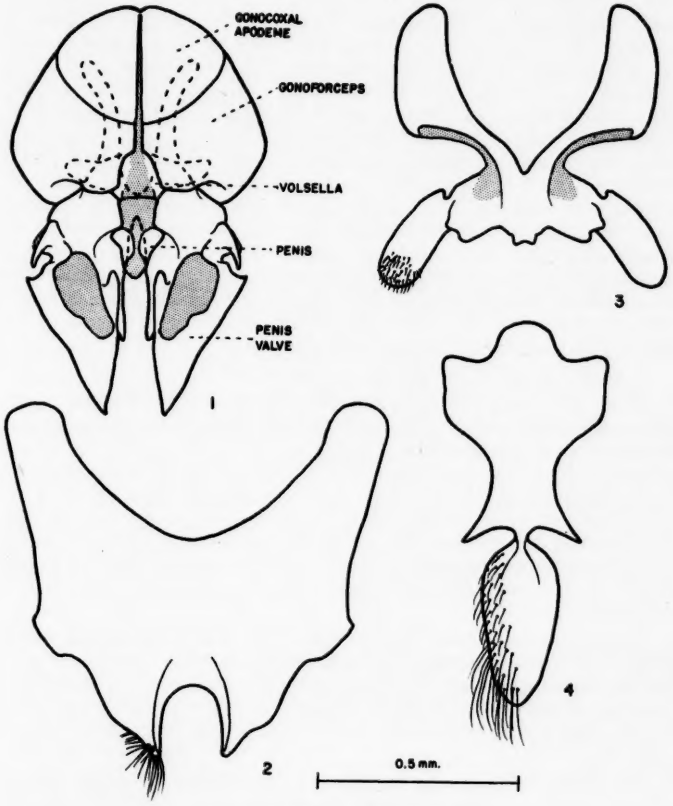
This species is closely related to *N. foleyi* Timberlake, *larreae* Timberlake, *barbata* Timberlake, *mellipes* Timberlake, *trifolii* Timberlake, *phaceliae* Timberlake, and perhaps *callosa* Timberlake. However, the male can be distinguished from all others by the combination of the facial color pattern and the hair brush on the hind femora. The very broadly interrupted yellow band of the second metasomal tergum serves to separate at a glance the female from all other females of the group.

Male: Length 5 to 5.5 mm.

Head: Integumental background color black to very dark brown; light markings very pale cream color. Hair greyish white, not extremely long and thick so as to obscure integument on clypeus as in *barbata* and *foleyi* or on supra-antennal area as in *phaceliae* and *foleyi*. Inner orbits converge somewhat toward clypeus but not as strongly as in *mellipes* and more strongly than in *phaceliae;* labrum mostly light; clypeus with median portion protuberant and extending considerably below level of lower margins of eyes; lateral portions bent strongly back, about as in *mellipes;* color dark except rarely for thin, longitudinal, median, light dash extending down from epistomal suture; punctures of clypeus large and somewhat irregularly spaced, somewhat similar to *mellipes;* each paraocular area light below and laterad of line drawn from point one-half to two-thirds way down inner orbit to point slightly laterad of anterior tentorial pit on epistomal suture; subantennal areas dark; supraclypeal area dark, sparsely punctured; vertex coarsely and heavily punctured. Scape entirely dark brown; pedicel dark brown; flagellum with upper surface dark brown, fading below to tawny. Mandibles light except at tip red; maxillary palpi subcylindrical; labial palpi having basal segment approximately three times length of following segments together.

Mesosoma: Integumental background color black to very dark brown. Hair greyish white in color. Pronotum entirely dark. Mesoscutum with anterior portion having punctures fairly coarse and somewhat irregularly spaced but about one-half puncture-widths apart; punctures becoming sparser posteromedially. Tegulae transparent light brown. Mesoscutellum with disk having punctation similar to that of posteromedial portion of scutum. Propodial triangle finely sculptured. Legs with color of light markings straw yellow, distinctly more vivid than color of facial maculations. Fore legs with femur dark except for light maculation extending at most one-fourth way up segment on anterodorsal surface; tibia with anterior and dor-

sal surface yellow; posteroventral surface entirely dark or light at base and apex; tarsus yellow. Middle legs with femur dark except for very small, apical, light maculation on anterodorsal surface; tibia varying in coloration from having very large dark maculation centered about one-half way down segment on both dorsal and ventral surface to having segment dark except for basitibial area; tarsus light. Hind legs with femur having large brush centered on ventral surface; femur dark except for small, apical, light maculation on



EXPLANATION OF FIGURES

Nomadopsis fracta Rozen, male

1. Ventral view of genitalia.
2. Ventral view of sixth metasomal sternum.
3. Ventral view of seventh metasomal sternum.
4. Ventral view of eighth metasomal sternum.

anterodorsal surface; tibia variable in coloration from having dark blotch centered about two-thirds way down segment on both anterior and dorsal surface to being completely dark; tarsus more or less symmetrical, not greatly distorted as in *australior, scutellaris,* and their allies; color yellow or tawny becoming darker toward apex. Wings faintly opalescent; veins light brown in color.

Metasoma: Integumental background color of dorsum black to dark brown except basad of graduli, where color fades into brown; background color of venter paler than that of dorsum. Terga with bands having color approximately same as light color of face; bands thin, gradually narrowing medially; area basad of bands having punctation rather coarse as in *mellipes;* area apicad of bands transparent brown. First metasomal tergum having band rarely interrupted medially and usually interrupted by sublateral dark spots; second metasomal tergum with band similar to that of preceeding except rarely completely interrupted by sublateral dark spots; third metasomal tergum with band similar to preceeding but more often interrupted by sublateral dark spots and usually not as narrow medially; fourth metasomal tergum with band similar to preceeding, usually interrupted by sublateral dark spots; fifth metasomal tergum with band similar to preceeding but usually somewhat broader and only slightly narrowed medially, always interrupted by sublateral dark spots; sixth metasomal tergum with band somewhat broader than other bands and uniform in thickness except for broad median notch along anterior margin; band not expressed laterad of sublateral dark spots. Sterna and genitalia as figured.

Female: Length 5.5 to 6.5 mm.

Head: Integumental background color, color of light markings as in male. Hair color greyish white; hair on supra-antennal area not extremely dense so as to obscure integument as in *larreae* and *foleyi.* Inner orbits subparallel; labrum dark; clypeus similar to that of male except not quite as protuberant, color always completely dark, and punctures slightly more scattered; each paraocular area with variable-shaped, light maculation immediately above and mesad of anterior mandibular condyle; occasionally maculation becoming very small; subantennal areas, supraclypeal area, and vertex as in male. Antennae as in male. Mandibles dark, becoming reddish toward tips; other mouthparts as in male.

Mesosoma: As in male except mesoscutum with posteromedial portion slightly more heavily punctured. Legs entirely brown or light brown except for basitibial area on fore leg which usually has small yellowish maculation; fore legs with basitarsus having hair amber in color, curved at tip, and extremely dense, more so than in *larreae, foleyi, barbata,* and *trifolii.* Wings as in male.

Metasoma: Integumental background color as in male. Terga with color of bands and punctation as in male; bands thin; area apicad of bands transparent to translucent brown. First metasomal tergum with bands usually briefly interrupted medially and usually interrupted by sublateral dark spots; second metasomal tergum with band absent mesad of sublateral dark spots; third metasomal tergum with band complete, gradually narrowing medially, and moderately excavated from behind by sublateral dark spots; fourth meta-

somal tergum with band somewhat similar to preceding except occasionally interrupted by sublateral dark spots; fifth metasomal tergum often dark, occasionally with bands expressed as two, lateral, light maculations.

Type Material: Holotype male, allotype female, twelve male and eighteen female paratypes: Andreas Canyon, Palm Springs, Riverside County, California, April 6, 1939 on *Eriodictyon trichocalyx* (C. D. Michener); seven male and twenty female paratypes: same data except April 10, 1936, on *Eriodictyon crassifolium* (error for *trichocalyx*); six male paratypes: same data except April 7, 1940, no flower data (R. M. and M. R. Bohart).

The holotype and allotype are in the Snow Entomological Museum.

Discussion: N. fracta apparently collects pollen primarily from *Eriodictyon,* although females carrying pollen have been taken on *Cryptantha* and Compositae. This species is well known from California and will probably be found in mountainous areas of California wherever *Eriodictyon* is found. Although it has not been taken outside the state, it will undoubtedly be collected in western Nevada, Oregon, and northern Baja California.

N. fracta has been taken from April 6 to June 26.

A NEW SPECIES OF HEBRIDAE (HEMIPTERA) FROM THE SOUTHWEST

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During the fall of 1950 I received a series of undetermined Hebridae from the U. S. National Museum. Among this group was a *Hebrus* sp. that did not have complete antennae. One was missing and the other lacked distal segments. This insect appeared different from the others and being a male, study of the genital capsule indicated this was an undescribed species. A few weeks later I received a series of specimens from the University of Kansas. Included in this group was a fine series of an undescribed species which were the same as the specimen from the National Museum.

Hebrus piercei n. sp.

Size: Macropterous male; length, 1.85 mm. to 2.00 mm.; width across humeri, 0.71 mm. to 0.74 mm.; macropterous female, length, 2.20 mm. to 2.25 mm.; width across humeri, 0.81 mm. to 0.89 mm.

Brachypterous female; length, 1.69 mm. to 1.79 mm.; width across humeri, 0.66 mm. to 0.69 mm.

Macropterous Form. (Fig. 1)

Color: Head fusco-piceous to piceous, clypeus lighter, compound eyes fusco-rufous, ocelli ferreous, antennae fulvous, all segments approximately concolorous; pronotum ferrugineous, lighter on disc, lateral edges of anterior lobe fuscous, median portion of collar testaceous; scutellum fuscous, lighter at apex; hemelytra with median portion of veins fuscous, base and apex fusco-piceous, membrane fulginious, with or without pale oval area at tip of

veins, clavus and corium fusco-testaceous. Underparts: Head with buccula testaceous to fusco-testaceous, rostrum testaceous, sternal ridges testaceous to fusco-testaceous, prosternum piceous to fusco-piceous, mesosternum and metasternum fuscous, legs testaceous, darker at joints, venter fusco-piceous. Genital capsule of male fusco-testaceous to fusco-piceous, basal rings lighter.

Structural Characteristics: Vertex of head without medial longitudinal sulcus, two anastomosing rows of tiny pits in this area, frons tumid; antenna with basal segment extending slightly less than half its length beyond the head, first and second segments stout, third, fourth and fifth filiform, first and third segments approximately equal in length, second and fourth approximately equal in length, fifth longer than second and fourth, shorter than first and third; pronotum with collar punctate on posterior lateral border, punctures evanescent on median area, with medial longitudinal sulcus on disc, deepest part of sulcus at juncture of anterior and posterior lobes, becoming evanescent on discs of anterior and posterior lobes, humeri impressed within, row of coarse punctures in depression, punctures continuing near posterior border of pronotum as an acupunctate line, humeri prominent and angulate, both discs of pronotum punctate, discs demarcated by row of coarse punctures; scutellum with medial longitudinal carina, bifid at apex, lateral edges upturned; hemelytra with inner vein produced or angulate, wing on one side may have inner vein produced while inner vein of opposite side may be angulate in same specimen, membrane may or may not extend to tip of abdomen, males have abdomen more constricted than females, connexivum turned upward in both sexes; underparts, rostrum extends approximately to center of first segment of venter, sternal ridges reduced on prosternum, prominent on mesosternum and metasternum; parameres of male curved sharply upward at distal end, hook longer than wide, posterior two-thirds of parameres with scattered coarse long setae.

Brachypterous Form. (Fig. 2)

Color: Head fuscous to fusco-testaceous, antennae testaceous, compound eyes fusco-rufous; pronotum fuscous to fusco-testaceous, collar testaceous; scutellum fuscous to fusco-testaceous; hemelytra with veins fuscous, membrane fulginious, lighter in corium and on clavus; abdomen with distal border of connexivum testaceous, basal portion fuscous, terga fuscous; underparts, tylus and anterior one-fourth of buccula fuscous, posterior three-fourths of buccula with dorsal half testaceous, ventral half light testaecous to very light yellow, nearly white in one specimen, rostrum testaceous; thorax with sternal ridges testaceous, prosternum testaceous, mesosternum and metasternum fuscous, legs testaceous to fusco-testaceous, darker at joints; abdomen with venter fusco-piceous, lighter near connexivum, vagina exterior fuscous.

Structural Characteristics: Head with medial longitudinal sulcus, compressed area around compound eyes, frons and tylus tumid, *ocelli lacking,* segments of antennae similar to macropterous form; pronotum similar to macropterous form except humeri are much reduced; scutellum not as well developed as in macropterous form, notch at apex not as well defined in some specimens but in others is similar to macropterous form; hemelytra much reduced but otherwise similar to macropterous form, inner vein

rounded; abdomen with connexivum sharply elevated; underparts, similar to macropterous form.

Comparative Notes: Near *Hebrus sobrinus* Uhler. However, *H. piercei* n. sp. can be readily separated from *H. sobrinus* Uhler by the parameres of the males. In specimens of *H. sobrinus* Uhler parameres are three parted at distal end while specimens of *H. piercei* n. sp. have a single upturned hook at the distal end.

Location of Types: Holotype male and allotype female in the Snow Entomological Museum.

Paratypes: macropterous forms, 51 males and 56 females; brachypterous forms, 5 females, as follows; Sabinal, Texas, IV-1910, Pierce and Pratt, 1 male, (U. S. N. M.); Sapello, New Mexico, VIII-25-1950, H. Wright, 1 male; Sabino Cn., Ariz., VII-7-1950, R. H. Beamer, 16 males and 12 females; Sabino Canyon, Ariz., 7-7-1950, L. D. Beamer, 4 males and 10 females; Wickenburg, Ariz., VII-5-1950, R. H. Beamer, 5 males and 5 females; Wickenburg, Ariz., 7-5-1950, L. D. Beamer, 13 males and 14 females; Carrizo Cr., Ariz., VI-16-1950, 7 males and 9 females; Oak Creek Can., Arizona, 6-28-1950, L. D. Beamer, 4 macropterous males, 6 macropterous females and 5 brachypterous females. Paratypes in the U. S. National Museum, Snow Entomological Museum and collection of author. Type locality, Sabino Canyon, Arizona.

Data on Distribution: Arizona, New Mexico, and Texas.

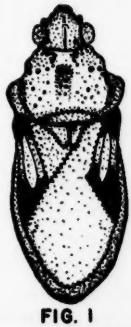

FIG. 1

FIG. 2

FIG. 3

FIG. 5

FIG. 4

FIG. 1 HEBRUS PIERCEI MACROPTEROUS FEMALE
FIG. 2 HEBRUS PIERCEI BRACHYPTEROUS FEMALE
FIG. 3 GENITAL CAPSULE OF MALE
FIG. 4 PARAMERE OF MALE
FIG. 5 SCUTELLUM OF MACROPTEROUS FEMALE

THE STATUS OF *Agromyza illinoensis* MALLOCH, 1934, AND ITS CORRECT GENERIC POSITION (AGROMYZIDAE, DIPTERA) [1, 2]

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Frick (1952) did not consider that Malloch (1934) had described *A. illinoensis* and designated the name a *nomen nudum*. However, a study of the type series in the Illinois Natural History Survey collection and three specimens in the U. S. National Museum collection has caused the writer to reverse his opinion. Although the description given by Malloch is very brief and not formalized, this characterization serves to separate the species from all other known North American species. Therefore, the name *illinoensis* Malloch, 1934, is here considered valid and the species placed in the genus *Cerodontha*.

The genus *Cerodontha* has been divided by Frey (1946) into two subgenera, *Cerodontha* Rondani and *Xenophytomyza* Frey. The subgenus *Xenophytomyza* was erected for two atypical European species possessing only two scutellar setae. These species, *Haplomyza atronitens* Hendel, 1920, and *Dizygomyza biseta* Hendel, 1920, were subsequently placed in the genus *Cerodontha* for convenience (Hendel, 1927). Hering (1927) presents a figure of the antennae of *C. biseta* to illustrate the type found in this group. *Cerodontha illinoensis*, herein redescribed, adds the Nearctic Region to the distribution of the subgenus *Xenophytomyza*.

Genus *Cerodontha* Rondani

Key to Subgenera

1. Third antennal segment bearing a spine or strongly projecting distally into the form of a claw; thorax and abdomen partially yellow ..... 1. *Cerodontha* Rondani
   Third antennal segment with a blunt angle distally; thorax and abdomen brown or black ..... 2. *Xenophytomyza* Frey

2. Subgenus *Xenophytomyza* Frey[3]

Xenophytomyza Frey, 1946, Not. Ent., 26:51.

Type: Haplomyza atronitens Hendel, 1920, by original designation.

Thorax, scutellum, legs, and abdomen entirely shining black or brown; body robust, thorax and abdomen not relatively elongate, slender; antennae with third segment bluntly angled distally, not bearing a spine or claw-like; mesonotum with acrostichal setae in 6 to 8 rows (absent or in 2 to 5 rows in *Cerodontha*); wing with costa usually reaching M_{1+2}, cross vein m-m present or absent; abdomen with sixth tergite one and one-half times to twice as

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[1] Scientific Paper No. 1124, Washington Agricultural Experiment Stations, Pullman.

[2] The writer wishes to thank Dr. H. H. Ross for the loan of all specimens of this species from the Illinois Natural Survey Collection and Mr. C. W. Sabrosky for critically reading portions of the manuscript and making available the three specimens in the U. S. National Museum collection.

[3] Gr., *xenos*, a guest; plus *phytomyza*.

long as the fifth tergite; male terminalia similar to those found in subgenus *Cerodontha*.

The species placed in the subgenus *Xenophytomyza* are distinct from the typical *Cerodontha* species. In fact, the writer hesitated to place *A. illinoensis* in the genus *Cerodontha* until the male terminalia had been studied. On the basis of the dark coloration and robust body form this species belongs in *Phytobia* (*Praspedomyza*). The similarity of the male terminalia of *C. illinoensis* to those found in the subgenus *Cerodontha* appears to substantiate the value of two scutellar setae as a generic character.

Cerodontha (*Xenophytomyza*) *illinoensis* Malloch, new combination

Agromyza illinoensis Malloch, 1934, Dipt. Patag. S. Chile, 6:483; Frick, 1952, Univ. Calif. Publ. Ent., 8:374 (as *nomen nudum*).

Female: Brown, shining; genovertical plates, frontal triangle, and posterior half of frontal vitta yellowish-brown; proboscis yellow, palpi brown;

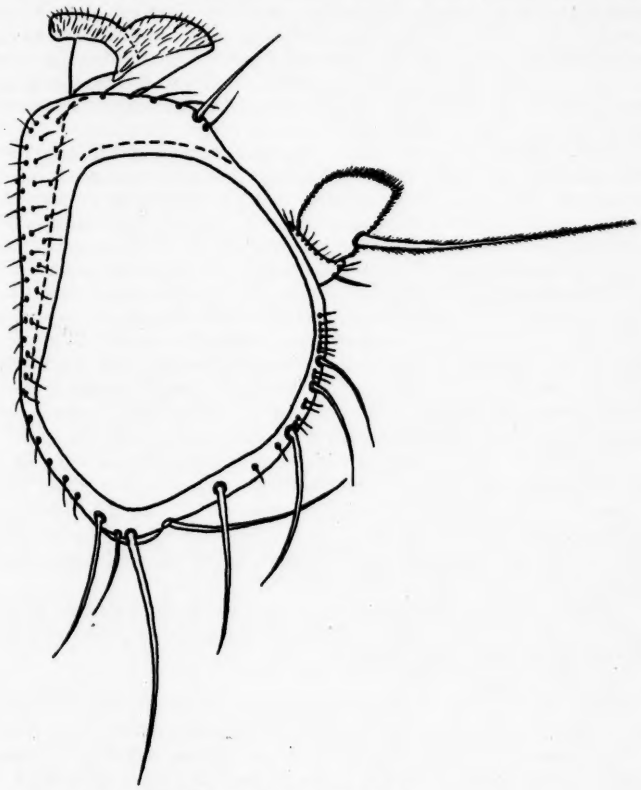

Fig. 1. Lateral view of the head of the holotype female.

postscutellum yellowish; margin and fringe of calypter black; wing veins brown; halteres yellow; tibiae and tarsi dark brown; abdomen reddish-brown, posterior margin of sixth segment very narrowly yellow; seventh segment dark brown.

Head (Fig. 1): As viewed in profile, genovertical plates strongly raised above eye margin; gena narrow, about one-seventh eye height, slightly widening posteriorly; eye about four-fifths as wide as high; vibrissa long, about two-thirds the length of a lower fronto-orbital seta. Antennae with third segment subquadrate, outer dorsal angle blunt, obtuse, not concave dorsally; setulae subequal in length to basal aristal thickness; arista in length subequal to eye width. Genovertical plates relatively broad, each about one-fifth distance between eyes; sharply raised above frontal vitta; each bearing 2 strong upper fronto-orbitals, dorsally and slightly inwardly curving, and 2 lower fronto-orbitals, inwardly and slightly upwardly curving; orbital setulae long, about one-third the length of posterior upper fronto-orbital, about 12 on a side, dorsally and inwardly curving. Frontal triangle shining, about twice as large as ocellar triangle, broadly rounded anteriorly. Ocellar triangle of normal size but ocellar setae very long, reaching nearly to lunule; ocellar setae very widey spaced, distance between them equal to the distance between the outer margins of the 2 posterior ocelli.

Thorax: Mesonotum with 3+1 dorsocentral setae; first pair long, strong, the second pair in length about three-fourths first pair, third about one-half the second, fourth pair slightly shorter than the third pair; all subequally spaced from one another; supra-alar seta strong; acrostichals relatively long, about one-third as long as fourth dorsocentral, numerous, in about 8 or 9 rows becoming sparser posterior to second dorsocentral, extending posteriorly to first dorsocentral; prescutellar seta absent; inner postalar weak, slightly less than one-fourth the length of the outer; intra-alar seta slender, about two-thirds the length of the second dorsocentral. Scutellum with 2 setae, the distal pair; long, strong. Humeri each with about 9 setulae plus the humeral; posterior notopleural seta about three-fourths the length of the anterior; 1 strong propleural seta; anepisternum with 1 dorsally and 5 posteriorly directed setulae, anepisternal seta strong; 1 strong katepisternal seta.

Wing: About twice as long as wide; costa reaching M_{1+2} at wing tip, second, third, and fourth costal sections as 10:4:3; cross vein m-m about 2 times its length from cross vein r-m; ultimate section of M_{1+2} about 5 times as long as penultimate; ultimate section of M_{4+5} about 1.5 times as long as penultimate; cubital plus plical vein strong, straight, nearly reaching wing margin.

Legs: Mid-tibial setae absent; distal tibial spurs short.

Abdomen: Tergites rather sparsely covered with short setulae; sixth tergite about twice as long as the fifth; seventh segment short, blunt, about one-half the length of the sixth tergite.

Size: Wing length 2 mm.

Male: Very slightly smaller than the female. Gena only about one-tenth the eye height; genovertical and mesofacial plates moderately raised above eye margin from vertex to gena, upper fronto-orbital setae only slightly inwardly directed; sixth abdominal tergite about 1.5 times as long as fifth, distal margin very narrowly yellow; ninth tergite about two-thirds as long as high,

slightly narrowing ventrally, covered with rather numerous minute setulae; cerci yellow.

Male terminalia: Typical for the genus (Frick, 1952) with the following modifications. Phallus with median section short, distal section greatly elongate and very slender, slightly sigmaform, distal expansions very small. Ninth tergite not broadening ventrally, anteroventral angles not extending anteriorly. Surstyli in the form of flattened plates, relatively slender, not extending ventrad of ninth tergite. Ejaculatory apodeme very small; base not sclerotized, bulb spherical, not sclerotized; stem short, blade small, subcircular, outer angles rounded.

Malloch's statements in 1934 lead one to suspect that Malloch thought the species previously described. In the Illinois collection one female specimen bears the following two labels on the pin: *"Agromyza illinoensis* Malloch (type)" and, "MS." In the U. S. National Museum collection there are two paratypes from Malloch's personal collection. The evidence indicates that the type series was collected during May, 1915, as the type and all three specimens in the U. S. National Museum collection bear that date. Seven more specimens, collected during May, 1915, are here considered part of the original type series. Eighteen specimens, dated in June, 1917, are not so considered. No type designations were made by Malloch. Therefore, to remove all doubt, I hereby designate Malloch's type and two paratypes as neotype and neoparatypes respectively. Also, the other seven specimens collected in 1915 are hereby designated neoparatypes, except for one male, designated the neoallotype.

Holotype ♀ (Neotype).—White Heath, Illinois, May 22, 1915; deposited in the Illinois Natural History Survey Collection, Urbana, Illinois.

Neoallotype ♂.—Topotypical, May 9, 1915; deposited in the Illinois Natural History Survey Collection, Urbana, Illinois.

Paratypes (Neoparatypes).—Topotypical: 1 ♂, 1 ♀, May 8, 1915; deposited in the U. S. National Museum collection.

Neoparatypes.—Topotypical: 1 ♂, May 9, 1915; 2 ♀ ♀, May 16, 1915; 2 ♀ ♀, May 22, 1915; 2 ♀ ♀, May 30, 1915. Neoparatypes have been deposited in the collections of the U. S. National Museum, Illinois Natural History Survey, and the writer.

Other specimens studied.—Topotypical: 2 ♂ ♂, 4 ♀ ♀, June 2, 1917; 5 ♂ ♂, 7 ♀ ♀, June 3, 1917.

Malloch (1934) briefly compared *A. illinoensis* with *Dizygomyza biseta* Hendel, which was later placed in *Cerodontha*. *C. illinoensis* differs from *C. biseta* in being brown instead of black, in not having the dorsal margin of third antennal segment concave and the distal angle more blunt, and in having the genovertical plates raised above the eye margins; from *C. atronitens* it has 3+1 dorsocentral setae, the costa reaching M_{1+2}, and cross vein m-m present. *C. illinoensis* is very distinct from any North American species known to the writer.

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A NEW HEBECEPHALUS[1] (Homoptera, Cicadellidae)

E. B. WITTLAKE AND R. H. BEAMER
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Below is described a new species of Hebecephalus collected in Canada in 1937.

Hebecephalus pedecurtus n. sp.

Resembling *Hebecephalus occidentalis* B. and T. in general color and markings, but lighter, with very short, stout non-pediform foot of style and with the lateral apical processes of the aedeagus diverging from shaft at an angle of approximately 60 degrees instead of 45 degrees or less as in *H. occidentalis* B. and T. Length, male 3.1 mm.; female 3.3 mm.

Structure: Vertex bluntly angled, one sixth to one fifth wider between the eyes than length at middle. Elytra longer than abdomen.

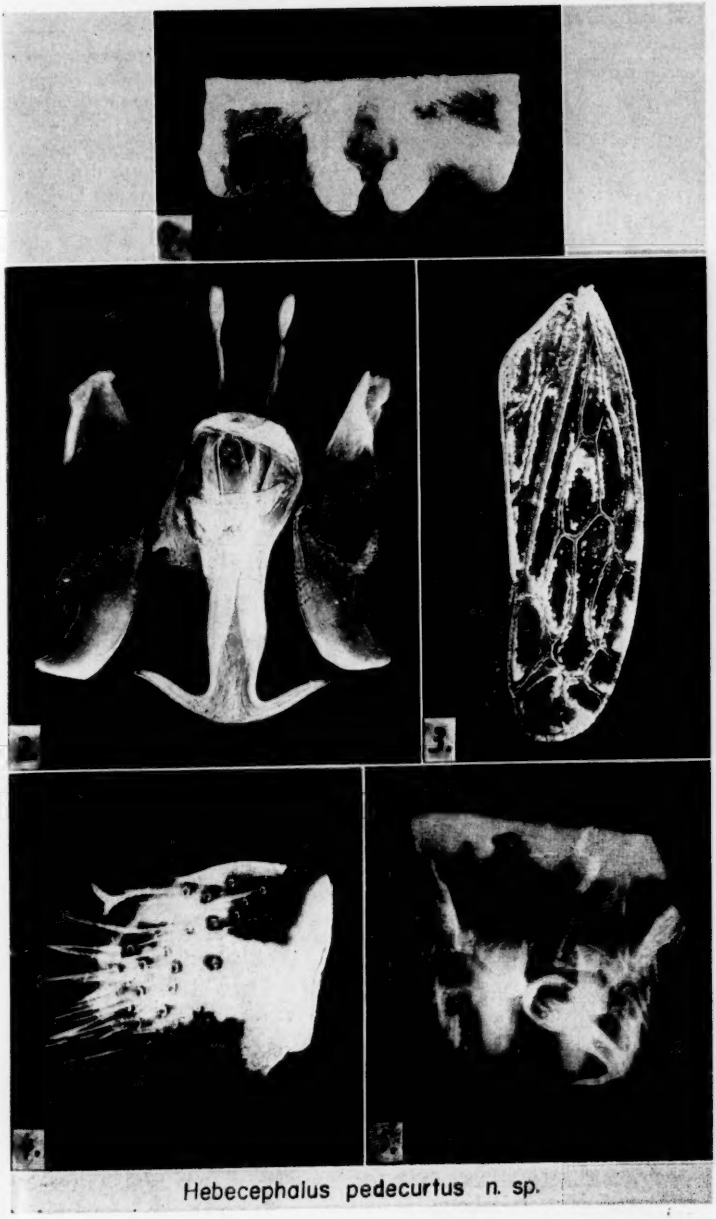
Color: More or less cinereous with fuscous markings. Vertex with two oblique triangular apical dark spots, disc with two pairs of transverse irregularly rectangular dark markings. Pronotum irregularly flecked with fuscous, with a gray cast. Scutellum same color as promotun. Elytra bordered by fuscous, irregular fuscous spots, light in various cells; veins white, bordered with fuscous.

External Genitalia: Last ventral segment of female with lateral posterior margins rounding and continuing mesad, moderately sinuate with median lobes extending two thirds their total length posteriorly beyond posterior

[1] Contribution No. 799, Department of Entomology, University of Kansas.

PLATE I
Hebecephalus pedecurtus n. sp.

Fig. 1. Last ventral segment of female.
Fig. 2. Dorsoventral view of aedeaegus and styles.
Fig. 3. Dorsal view of right elytron.
Fig. 4. Lateral view of pygofer.
Fig. 5. Ventral view of male plates.



Hebecephalus pedecurtus n. sp.

points of lateral margins. Median notch as deep as sinuses on posterior margin. Male valve wider than long. Plates slightly wider than valve, bluntly rounded distally. Pygofer with a short, stout, slightly curved, bluntly pointed hook on posterior ventro-lateral angle.

Internal Genitalia: Aedeagus short and stout, not radically curved dorsad and very flat in lateral view, apical pair of lateral processes, retrorse, divergent at an angle of 60 degrees, with apical quarter of processes directed laterad. Style with short, bluntly pointed foot.

Types: Holotype, male; allotype, female; paratypes: one male and one female, Hartney, Manitoba, July 31, 1937, R. H. Beamer; one female, Swan River, Manitoba, August 2, 1937, R. H. Beamer; one female, Woodside, Manitoba, August 8, 1937, R. H. Beamer.

All types deposited in the Snow Entomological Museum.

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